

## Section 25

### Concrete, Masonry Construction, and Formwork

This section sets forth the requirements for concrete, masonry construction, and formwork. It specifically addresses plant and equipment, concrete conveyance systems, reinforcing steel, surface preparation, formwork and falsework, vertical shoring, tubular welded frame shoring, tube and coupler shoring, single-post shores, vertical slip forms, releasing and moving forms, precast concrete, lift-slab, and masonry construction.

#### 25.1 Plant and Equipment

**25.1.1 General.** Design, operate, and maintain all equipment, facilities, and formwork for concrete and masonry construction according to the requirements of this section, other applicable parts of these standards, the subsection, "Other Mechanized Construction Equipment," and the current edition of ANSI A10.9, "Construction and Demolition Operations—Concrete and Masonry Work."

**25.1.2 Batching and Screening Plants.** Design and construct concrete batching and screening plants, aggregate production plants, hoppers, bins, silos, and related equipment with an adequate safety factor to prevent structural failure or collapse. Refer to the subsection, "Other Mechanized Construction Equipment" for certification requirements. Design and equip batching plants, aggregate plants, and conveyor systems with mechanical dust control systems and water spray systems (or other acceptable means) to keep airborne dust concentrations within acceptable exposure limits. Comply with permit-required confined space and hazardous energy control procedures when entering silos, storage bins, tunnels, shafts, or similar enclosed areas.

**25.1.3 Bulk Storage Bins.** Bulk storage bins, containers, and silos must have conical or tapered bottoms and be able to start material flow mechanically or pneumatically.

**25.1.4 Loading Skips.** Install protective guardrails on each side of loading skips if loading skips are one cubic yard or larger. Equip loading skips with a mechanical device to clear the skip of material.

**25.1.5 Bull Floats.** Where bull float handles may contact energized electrical conductors, establish a hazardous energy control clearance and lock out the power to those conductors.

**25.1.6 Powered Concrete Trowels.** Equip manually guided powered and rotating concrete troweling machines with a control switch or positive mechanical release device that automatically stops trowel rotation when the operator releases the equipment handle.

**25.1.7 Concrete Buggies.** Handles of concrete buggies must not extend beyond the wheels on either side of the buggy.

**25.1.8 Concrete Buckets.** Concrete buckets equipped with hydraulic or pneumatically operated gates must have positive safety latches or similar safety devices to prevent premature or accidental dumping. Design the buckets so aggregate does not accumulate on the bucket's top and sides. Do not ride concrete buckets or permit personnel under buckets that are being raised or lowered into position by cranes or cableways. Do not route elevated concrete buckets over employees. Concrete buckets with manually operated gates must be self-closing. Maintain all buckets in structurally sound condition. A professional engineer (PE) must approve any alterations that affect structural competency.

**25.1.9 Transmix Trucks.** Transmix trucks and concrete pumping trucks, including operating procedures, must conform with requirements in this subsection and the subsection "On-Highway Equipment."

**25.1.10 Personal Protective Equipment.** Employees placing or finishing concrete must wear applicable protective equipment, but never less than long-sleeved shirts, long pants, rubber safety boots, gloves, hardhat, and eye glasses with side shields. Make eyewash facilities available at each placement or finishing operation.

**25.1.11 Lockout/Tagout.** Lock out and tag equipment, such as compressors, mixers, screens, and concrete pumps, before performing maintenance or repair work.

## **25.2 Concrete Conveyance Systems**

**25.2.1 General.** "Concrete Conveyance Systems" are defined as mechanical devices used to move concrete from the receiving hopper of the system to the point of use (i.e., pumps, tremies, conveyor belts, flexible hoses, pipelines, and the structures or mobile equipment on which the system is installed). They do not include concrete buckets hoisted by cranes, cableways, or specialized hoisting systems, or transmix trucks used to convey concrete from the batch plant to the placement site. These types of mechanical devices are covered elsewhere in these standards.

**25.2.2 Requirements.** The manufacturer or a PE must design and certify all concrete conveyance systems as safe for intended use. The contractor or owner/operator must operate, maintain, inspect, and test the systems in accordance with the more stringent requirements set forth in the manufacturer's instructions, PE's specifications or these standards.

### 25.2.3 Concrete Pumping Systems

a. **General.** Concrete pumping systems consist of a concrete pump, pipeline (slickline) including short or long beds, couplings, intermediate and end hoses, and all supporting structures and equipment. Pipe accessories may include shutoff valves, direction change valves, articulating pipe connections, telescoping pipes, cleaning heads, trap baskets, and taper (transition) pieces. Concrete pumping systems may be stationary or mobile, or a combination of both types.

Design, install, test, and operate all systems and supporting equipment according to the more stringent requirements contained or referenced in these standards or in the manufacturer's or PE's specifications.

b. **Concrete Pumping Line** (slickline, intermediate or end hoses, bends, couplings, transitions, etc.).

1. **General.** The manufacturer must certify that all materials, pipes, and accessories are safe to use in concrete pumping systems and are within the calculated design pressures. Remove piping and accessories from service whenever rupture safety factors (bursting pressure divided by maximum obtainable pump pressure) are less than two (and, preferably, four). All hoses must be approved for concrete pumping operations and maximum anticipated operating pressures. Affix maximum approved operating pressures to the hose. Install hoses according to manufacturer's approved methods and procedures. Provide safety lashings that can support a fully loaded hose at all hose connections. The manufacturer must approve, in writing, any field repairs to hoses, pipes, or couplings.

2. **Couplings.** Couplings may be bolt, snap, toggle, or cup-tension type. Secure snap or toggle couplings against accidental opening using safety pins or equivalent devices (see figure 25-1). Clearly mark couplings with shoulder diameter and pressure rating. Couplings must have a pressure rating two times greater than the pump's maximum manufacturer's rating. Adjustable coupling eyebolts must have stops on adjustment threads to prevent overadjusting.

#### 3. **Assembly**

(a) A competent person, trained and experienced in the type of systems being installed, must directly supervise their assembly. Do not assemble or use a concrete pumping system on the construction site unless the system supervisor has a manufacturer-approved piping wall thickness monitoring and replacement procedure (ultrasonic, weepholes, etc.). Test all piping system components in

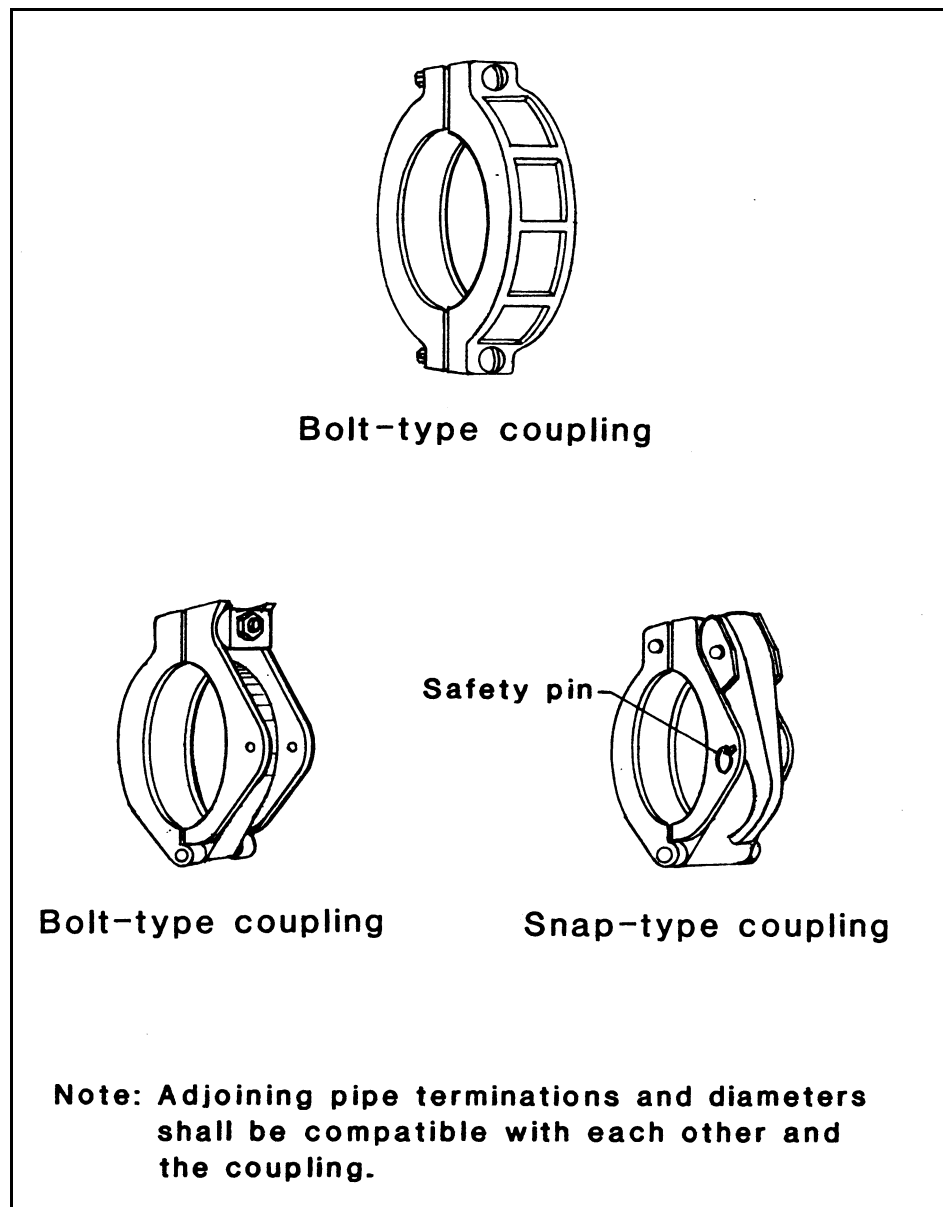


Figure 25-1.—Pipe couplings.

accordance with the procedure before onsite use, unless written evidence proves that a satisfactory testing procedure is in place and functioning.

(b) Adjoining pipe terminations must be compatible with each other and the coupling. Mating pipe terminations must be the same diameter as marked on the coupling. It is not acceptable to construct the flange shoulder by welding,

screwing, or otherwise attaching an external ring to the pipe or grooved-type flanges the same diameter as the pipe.

(c) Securely brace and anchor all piping to minimize movement and to ensure that line parts will be restrained if failure occurs. A PE or the manufacturer must approve any piping attached to or supported from structural members or formwork, as well as piping installed on equipment that may impose loadings beyond design criteria.

### c. **Placing Booms**

1. **General.** The manufacturer or a PE must design and certify placing booms and all supporting structures or equipment. Delivery piping, intermediate or end hoses, couplings, and accessories supported by or used with placing booms must conform with this section. Anchor each section of rigid pipeline or hose to the boom, so no section can fall from the boom in the event of coupling or adapter failure. Metal pipe swivels are the preferred method for accommodating boom folding actions.

Equip all hydraulic cylinders with hydraulic pressure relief valves that automatically prevent boom or cylinder damage. Use placing booms only for hoisting system piping, accessories, and the concrete being conveyed.

2. **Mountings.** Design and operate trailers and trucks with mounted placing booms (see figure 25-2) according to the requirements in the section, "Mobile and Stationary Mechanized Equipment" and Department of Transportation regulations. Inspect and brake test them in accordance with the references above. The manufacturer or a PE must design stationary boom mountings. Visibly display the weight of booms, attachments, and accessories on the boom. Clearly display on the boom or in the operating instructions all outriggers, jacks, or other stabilizing features required by the manufacturer or PE. Visibly mark outriggers with maximum load imposed on supporting surface. Locate outrigger controls so the operator can continuously observe the outrigger whenever it is being extended or retracted.

### 3. **Controls and Gauges**

(a) Mount permanently installed controls so the boom or other moving parts cannot strike the operator and so the operator has a clear view of the receiving hopper. Adequately light control panels and operator platforms during night operations. Access to elevated control stations must be in accordance with these standards. Fall protection systems meeting requirements in the section,

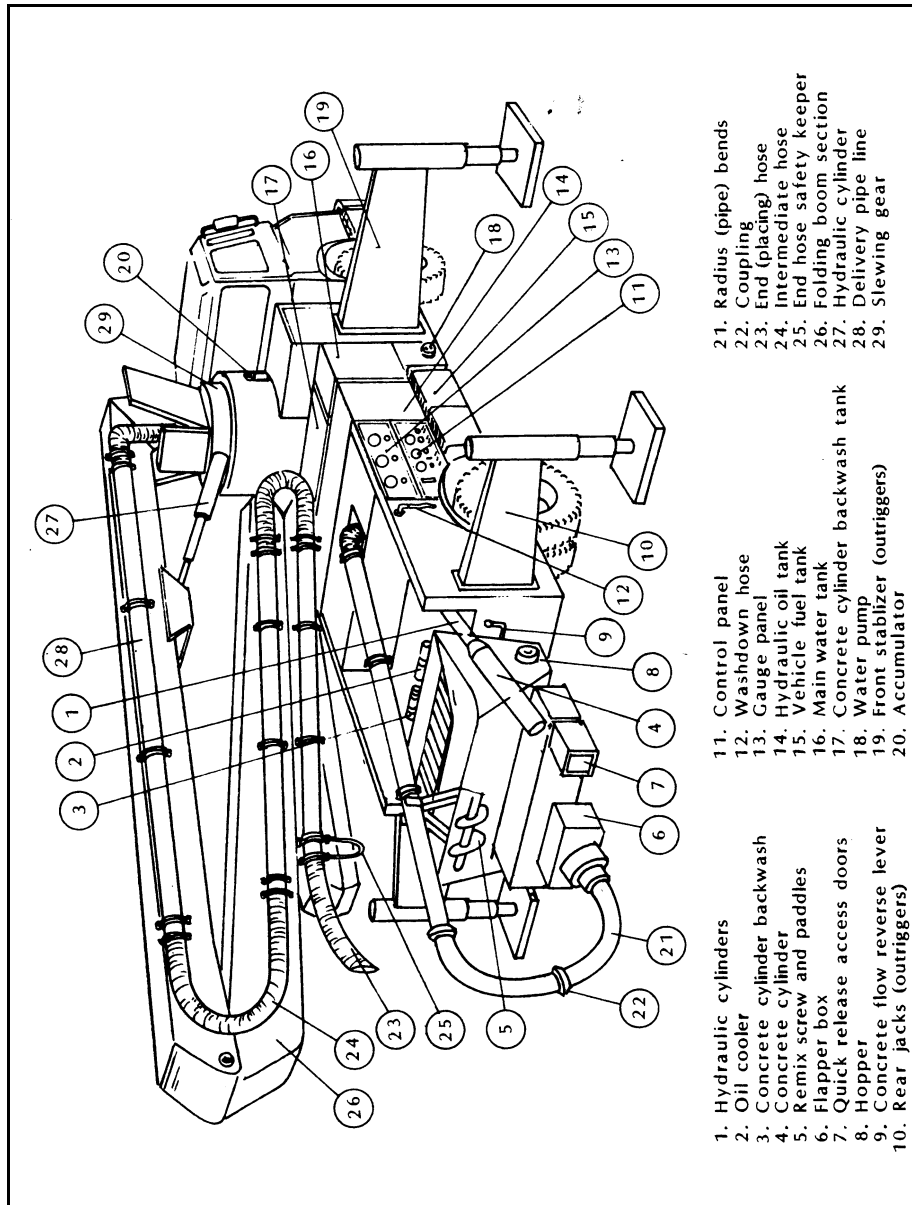


Figure 25-2.—Crane boom mounted concrete conveyor system.

"Mobile and Mechanized Stationary Equipment," must be in place on the platform. Protect all operating platforms with adequate guardrails.

(b) Mark all controls with symbols or wording that clearly shows their function. When possible, ensure that the direction of control movement corresponds with direction of motion. Arrange the controls to prevent unintentional motion by the operator. All controls must be deadman type.

- (c) Ensure that combination stationary and remote control systems for booms can only be operated from one location at a time. All control panels (stationary or remote) must lock in the "off" position when unattended.
- (d) When the operator cannot see gauges that detect critical temperatures and pressures, equip the pumping system with automatic shutoff or control devices that limit temperatures or pressures to within predetermined safe limits.
- (e) Provide an emergency, all function, stop button on all control panels. The button must be easily identifiable by size and color and be accessible from the normal working surface.
- (f) Radio remote controls must be Federal Communications Commission (FCC) certified for two-way communication and have shielding, filtering, and discrete coding to prevent accidental stimulation of the receiver.

#### 4. Performance Inspection and Testing

- (a) **Stationary Mounting.** After making major repairs or alterations to critical structural members, or when directed by the Contracting Officer's Representative (COR) or office head, performance inspect and load test stationary-type placing booms in accordance with the manufacturer's or PE's instructions.

Initially mounting a placement boom on a new stationary supporting structure, or at a new location, is considered a major alteration. Performance and load testing must be completed before use at the new location. When moving the boom between tested structures or locations, additional load tests are not necessary, unless required by the COR or office head. However, operationally test the placement boom before conveying concrete. This test must include: (1) fully extending all boom sections to a horizontal position with end hose attached; (2) rotating the boom through 360 degrees or maximum degrees of operation; (3) raising extended boom to vertical position and rotating through 360 degrees or maximum degrees possible; and (4) testing relief valve settings by folding boom sections against each other.

- (b) **Mobile Mountings.** Performance inspect and load test placement booms mounted on truck chassis or trailers after repair or alterations to critical components and when directed by the COR or office head. Further, when relocating them to any load tested location, subject them to the more stringent operational test described in the previous subparagraph or in the manufacturer or PE's instructions. The load testing requirement for supplier-owned and operated truck- and trailer-mounted units may be waived when: (1) the equipment is used

onsite sporadically or for short intervals; (2) no critical defects are found after visual inspection and conducting operational tests; (3) the owner/operator has written confirmation that the boom and supporting equipment have satisfactorily passed a performance inspection and load test following the repairs or alterations.

(c) **Performance Inspection and Load Test Procedures.** Conduct performance inspections of all critical components to ensure they meet the minimum recommended levels specified in the manufacturer's or PE's operating or inspection manuals. If the information is unavailable, the manufacturer or PE must develop it for use in making the inspection. Conduct load tests with test weights spaced along the boom as specified by the manufacturer or PE. Load test data supplied by the manufacturer or PE is unacceptable unless it adequately tests all critical structural components and tipping moments to 100 percent of manufacturer's maximum rated conditions, and load-limiting devices are tested to activating limits.

#### **d. Concrete Pumps**

1. **General.** A manufacturer or PE must design and certify concrete pumps for intended use and pressures. Truck chassis, trailers, skids, or railcars that have mounted pumps must conform with applicable requirements of these standards, including the sections on "Mobile and Mechanized Stationary Equipment" and "Tunnel and Shaft Construction," and this section. Skid-mounted pumps must have sufficient eyes for attaching slings or special hoisting devices. Affix a permanent notice to the pump, stating overall weight of pump and supporting structures.

Support, anchor, and stabilize pumps in accordance with manufacturer's or PE's requirements. All docks, outriggers, or axle locks specified by the manufacturer or PE must accompany the unit and be placed in recommended operating position before starting pumping operations.

2. **Controls and Gauges.** Mount permanently installed controls so the operator can observe all critical pump components. Adequately light control panels and operating platforms during night operation. Mark controls with symbols or wording that clearly shows their functions. Ensure that combination stationary and remote control panels for pumps can only be operated from one location at a time.

All control panels must lock in the "off" position when unattended. If the operator cannot directly view gauges for detecting critical temperatures and pressures, equip them with an automatic shutoff or control devices that limit temperature and pressure to within predetermined safe limits. Provide an emergency shutoff button on all control panels. The buttons must be easily identifiable by size and color and be



accessible from normal work surfaces. Radio remote controls must be FCC certified for two-way communication and have shielding, filtering, and discrete coding to prevent accidental stimulation of the receiver.

**3. Specific Requirements.** Guard all dangerous moving parts. Position the receiving hopper so concrete can readily flow from transmix trucks or other concrete conveyance equipment discharge chute into the hopper. Provide a hinged grill to prevent access to dangerous moving parts. Securely mount the grill on the hopper with an interlocking arrangement that prevents access until feed, agitator, and valve mechanisms are rendered inoperative. Grill parallel bar spacings must be no more than 3/4 inches apart and be able to support a 250-pound load.

Construct inlet and outlet valves and chambers to restrict personnel access until all energy sources are locked out and stored energy is dissipated.

**e. General Operating Requirements**

1. Competent personnel must install and operate concrete pumping systems and equipment.
2. Personnel may work on piping systems or supporting structures only after all inline pressures have been relieved by running the pump in reverse or opening air or water relief valves.
3. Position pumps so trucks can avoid backing. If backing is necessary because of site conditions that you cannot modify, a signal person must stand to the side of the truck and direct it. Prevent pedestrians and vehicle traffic from entering the pump area during backing operations.
4. Trucks with installed pumps and placing booms that use truck engine power to operate the equipment must conform fully with the "Mobile and Mechanized Stationary Equipment" section and all other applicable provisions of these standards.
5. End hoses must not exceed lengths specified by the manufacturer or PE. Do not allow placing booms to drag end hoses laterally. Manually relocate hose using pulling slings.
6. When operating or transporting placing booms close to high-voltage power lines, comply with these and other applicable standards.
7. When relocating placing booms and end hose outside the operator's visible range, a signal person must give full attention to directing the operation.

8. Do not externally brace placing booms or lay them on any supporting structure during pumping operations unless approved by the manufacturer or PE.
9. All outriggers, jacks, or other stabilizing features required by the manufacturer or PE must accompany the boom or pump and be in recommended operating position before conveying concrete.
10. Do not relocate mobile-mounted placing booms or withdraw outriggers unless the boom is in defined transport position.

### **25.3 Reinforcing Steel**

**25.3.1 Lateral Supports.** Laterally support reinforcing steel for walls, piers, columns, and similar structures to prevent overturning or collapse. The lateral supports for reinforcing steel must be able to withstand the forces applied during construction.

**25.3.2 Rigging.** Securely tie together bundles of reinforcing steel before moving by crane or cableway to prevent slipping. Use two-part slings to handle steel more than 20 feet long.

**25.3.3 Impalement.** Cover exposed rebar onto or into which employees could fall to eliminate the hazard of impalement. Do not use plastic cap coverings for impalement protection, but you may use them to cover the ends of horizontal rebar. Cover vertically protruding rebar with wood troughs or other substantial material.

**25.3.4 Positioning Device Systems.** Employees must use a positioning device (see the section on "Fall Protection") when working in a stationary location 6 feet or higher above any adjacent work surfaces or when placing and tying reinforcing steel in walls, piers, columns, etc. Employees must use a personal fall arrest system meeting the requirements of the section on "Fall Protection" when moving on reinforcing steel higher than 24 feet above adjacent surfaces.

**25.3.5 Walkways.** Reinforcing mats used as walkways must have planking to ensure safe footing.

**25.3.6 Prohibited Uses.** Do not use reinforcing steel as guy attachments at deadmen or other anchorage points for scaffolding hooks, for stirrups, or as a load-bearing member of any lifting device.

**25.3.7 Wire Mesh Mats.** Secure wire mesh reinforcing mats at each end to prevent recoiling. Secure unrolled wire mesh on each side of a proposed cut before cutting the mesh.

**25.3.8 Post-Tensioning Operations.** Do not permit employees, except those essential to post-tensioning operations, to be behind the jack during tensioning operations. Erect signs and barricades to limit employee access to the post-tensioning area during tensioning operations.

## 25.4 Surface Preparation

**25.4.1 Green Cutting or Abrasive Blasting.** Employees engaged in green cutting must wear eye and face protection. Employees engaged in wet or dry abrasive blasting using silica sand must wear an approved abrasive blasting air-line respirator, heavy-duty footwear, and hardhat. (See the section, "Personal Protective Equipment," for specific requirements.)

**25.4.2 Safety Factor.** Design, erect, brace, and maintain formwork, falsework, structural shoring, and bracing to safely support all vertical and lateral loads that might be applied until the structure can support such loads. Incorporate the minimum safety factors (as specified in ANSI A10.9, "Construction and Demolition Operations - Concrete and Masonry Work") in the design and erection of all framework, shoring, falsework, and formwork accessories.

**25.4.3 Construction Loads.** Do not impose any construction loads on the partially completed structures unless such loading has been considered in the design and is shown on the formwork design drawings or specifications.

### 25.4.4 Drawings and Plans

a. A PE must approve and sign detailed design calculations and working drawings for all formwork or vertical shoring installations when any of the following conditions exist:

- The height, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet
- Individual horizon span lengths exceed 16 feet
- Provisions are made for vehicular or railroad traffic through the falsework or vertical shoring.

b. For all formwork and vertical shoring installations not discussed in subparagraph a. above, one of the following must approve and sign the formwork plan or shoring layout:

- A PE
- A manufacturer's authorized representative

- A contractor's representative, qualified in using and erecting formwork and vertical shoring.

c. Make drawings or plans showing the jack layout, formwork, shoring, working decks, and scaffolding available at the jobsite.

**25.4.5 Form Anchors.** Design form anchors that support forms and scaffolding with a minimum safety factor of three. Impose no load on form anchors or concrete anchorages until the concrete has set the minimum period of time set forth in the subsection, "Releasing and Moving Forms." Form sections supported by form anchors must be no more than 50 feet long and must be designed and installed so that no forces, incurred by form or anchorage failure, can transfer to an adjacent section.

**25.4.6 Housekeeping.** In all areas where persons must work or pass, remove and stockpile all stripped forms and shoring promptly after stripping. Pull or cut protruding nails, wire ties, and other unneeded accessories to avoid hazards.

**25.4.7 Fall Protection.** Employees, when working 6 feet or more above any adjacent work surface (and not protected by fixed scaffolding, guardrails, or safety net) must use a personal fall protection system. Employees working in a stationary position may use a positioning system, but only until they need to relocate to a new position.

## **25.5 Vertical Shoring**

**25.5.1 Additional Loading.** Temporarily store reinforcing rods, materials, or equipment on top of formwork only if structures have been designed or strengthened to support the additional loading. Do not load eccentric loads on shore heads or similar members, unless these members are designed for intended loading.

**25.5.2 Sills.** Sills used in shoring must be sound, rigid, and able to carry the maximum intended load.

**25.5.3 Shoring Equipment.** Inspect all shoring equipment before erection to make sure it conforms to the shoring layout. Do not use damaged equipment for shoring.

**25.5.4 Inspection.** Inspect erected shoring equipment immediately before, during, and after placing concrete to make sure shoring equipment meets the requirements specified on the formwork drawings. Immediately reinforce or reshore any damaged or weakened shoring equipment.

**25.5.5 Reshoring.** Provide reshoring when necessary to safely support slabs and beams after stripping or where such structures are subject to superimposed loads.

**25.5.6 Removal of Shoring.** Remove shoring equipment only after concrete has reached the minimum strength required in the formwork and shoring design and a PE or supervisor has inspected and approved the placement. Plan removal so you do not overload in-place shoring equipment.

## **25.6 Tubular Welded Frame Shoring**

**25.6.1 Safe Loading.** Do not load metal tubular frames used for shoring beyond the safe working load recommended by the manufacturer. Design metal tubular frame shoring with a minimum safety factor of 2.5.

**25.6.2 Condition.** Locking devices on frames and braces must be in good working order; coupling pins must align the frame or panel legs; pivoted cross braces must have their center pivot in place; and all components must be in good serviceable condition. Promptly repair or replace faulty or damaged parts and components.

**25.6.3 Inspection.** Make a thorough inspection after erection to ensure that: (1) spacing between towers and cross brace spacing does not exceed that shown on the layout and that all locking devices are in the closed position; (2) the devices for attaching the external lateral stability bracing are securely fastened to the legs of the shoring frames; (3) baseplates, shoreheads, extension devices, or adjustment screws are in firm contact with the footing sill and the form.

## **25.7 Tube and Coupler Shoring**

**25.7.1 Design.** Design the tube and coupler shoring for the maximum intended loading with a minimum safety factor of 2.5.

**25.7.2 Couplers.** Couplers (clamps) must be of structural-type metal, such as drop-forged steel, malleable iron, or structural grade aluminum. Do not use gray cast iron or couplers that are deformed, broken, or have defective or missing threads or bolts.

**25.7.3 Inspection.** Make a thorough inspection after erection to ensure that:

- a. The shoring has been erected as shown on the layout drawings.
- b. The spacing between posts does not exceed that shown on the layout.
- c. All interlocking tubular members and couplings are properly installed and tightened.

- d. All baseplates, shore heads, extension devices, or adjustment screws are in firm contact with the footing still and the form material and snug against the legs of the frames.

## **25.8 Single-Post Shores**

**25.8.1 Design.** Single-post shoring layouts must provide for the maximum intended loading with a minimum safety factor of 3. When using single-post shores in more than one tier, a PE with structural experience must design and inspect them.

**25.8.2 Bracing.** Horizontally brace single-post shores longitudinally, transversely, and diagonally. Install the bracing while erecting shores.

**25.8.3 Inspection.** Inspect single-post shores and adjusting devices before use. Do not use fabricated shores and adjusting devices that are heavily rusted, bent, dented, rewelded, damaged, or defective. Do not use timber shores and timber components of fabricated shores if split, knotted, broken, or otherwise structurally defective.

**25.8.4 Baseplates and Shore Heads.** Baseplates and shore heads of single-post shores must be in firm contact with the footing sill and the form materials.

**25.8.5 Angled Formwork.** When formwork is at an angle or sloping, or when the shored surface is sloping, specially design the shoring for such loading.

**25.8.6 Adjustment.** Do not adjust single-post shores after concrete is in place.

## **25.9 Vertical Slip-Forms**

**25.9.1 Design and Supervision.** A PE, experienced in slip-form design, must design all vertical slip-forms. Drawings prepared by the PE, showing the jack layout, anchorages, formwork, scaffolding, etc., together with installation, jacking, and leveling instructions, must be available at the jobsite and followed. A person experienced in slip-form operations must supervise form installation, movement, and leveling.

**25.9.2 Jack Supports.** Design steel rods or pipe on which the jacks climb (or by which forms are lifted) for that intended purpose. Encase supports in concrete or anchor them. Supports anchored or secured by form anchors must use two or more independent form anchors, separated a minimum of 5 feet vertically.

**25.9.3 Vertical Loading.** Position jacks and vertical supports so the vertical loads are distributed equally. Do not exceed the capacity of the jacks.

**25.9.4 Line and Plumb.** Keep the form structure in line and plumb during jacking operations.

**25.9.5 Lifting.** When lifting, proceed steadily and evenly. Do not exceed the predetermined safe rate of lift.

**25.9.6 Bracing.** Provide lateral and diagonal form bracing to prevent excessive distortion of the structure during jacking.

**25.9.7 Holding Devices.** Provide the jacks or other lifting devices with mechanical dogs and other automatic holding devices to provide protection in case the power supply or the lifting mechanism fails.

**25.9.8 Scaffolding and Platforms.** Vertical lift forms must have scaffolding or work platforms that completely encircle the area of placement.

**25.9.9 Supervision.** An experienced supervisor must oversee vertical slip-form operations. The supervisor must be present on the deck during slipping.

## **25.10 Releasing and Moving Forms**

**25.10.1 Lifting.** When raising or moving forms by crane, cableway, A-frame, or similar mechanical lifting device, securely attach the forms to wire rope slings that have a minimum safety factor of eight. Equip the panels and form sections with hoisting brackets to attach slings. Remove loose tools and materials before moving forms. Use taglines for controlling forms whenever necessary to protect personnel or structures.

**25.10.2 Riding Forms.** Employees must not ride forms or form scaffolding as it is raised or moved, with the exception of vertical slip-forms.

**25.10.3 Releasing.** Adequately brace or secure vertical and overhead forms before releasing them. Before releasing and moving forms, relocate employees at lower levels who may be exposed to falling materials.

**25.10.4 Form Removal.** Do not remove forms until the concrete being supported is sufficiently strong to support its weight with all loads placed on it, to ensure safe removal of the forms, shoring, and bracing.

## 25.11 Precast Concrete

25.11.1 **Requirement.** Brace precast concrete walls, structural framing, or tilt-up wall panels until after permanent connections are made. A PE must design temporary bracing that provides at least 15 pounds per square foot on projected surfaces.

25.11.2 **Temporary Bracing.** A PE must design temporary bracing for precast concrete walls, structural framing, or tilt-up wall panels. Such bracing must provide at least 15 pounds per square foot on projected surfaces.

25.11.3 **Suspended Loads.** Do not allow employees under precast concrete members being lifted or tilted into position.

25.11.4 **Lifting Inserts.** The lifting inserts for tilt-up concrete members must be able to support at least two times the maximum intended load. Other types of lifting inserts for precast concrete members must be able to support at least four times the maximum intended load. Lifting hardware must be able to supporting at least five times the maximum intended load.

## 25.12 Lift-Slab

25.12.1 **Lift-Slab Operations.** A PE, experienced in lift-slab construction, must design and plan lift-slab operations. Such plans must include detailed instructions and sketches that show the prescribed method of erection and ensure lateral stability of the building/structure during construction.

25.12.2 **Jacks/Lifting Units.** Mark jacks/lifting units to show the rated capacity established by the manufacturer. Design jacks/lifting units with a minimum safety factor of 2.5. Do not load jacks/lifting units beyond their rated capacity.

- a. Jacking equipment includes any load-bearing component used to carry out the lifting operation, such as threaded rods, lifting attachments, lifting nuts, hook-up collars, t-caps shear heads, columns, and footings.
- b. Design and install jacks/lifting units so they will neither lift, nor continue to lift, when loaded beyond their rated capacity.
- c. Install a safety device for jacks/lifting units to ensure that loads will remain supported in any position if jacks malfunction.

25.12.3 **Jacking Operations.** Synchronize jacking operations so the slab will remain level at all support points to within a ½-inch tolerance at all times.



- a. If leveling is automatically controlled, install a device that will stop the operation when the tolerance is exceeded or when the jacking system malfunctions.
- b. If manual controls maintain leveling, locate these controls in a central location; an experienced, competent person must attend the controls during lifting. Limit the maximum number of manually controlled jacks/lifting units on one slab so the operator can maintain the slab level. The maximum number must not exceed 14.
- c. Only employees who are not essential to the jacking operation may remain beneath a slab during lifting. During jacking operations, only employees who are essential to the jacking operation may remain in the building/structure.
- d. When making temporary connections to support slabs, secure wedges with tack welding, or an equivalent method, to prevent them from falling out of position. Release lifting rods only after securing column wedges.
- e. A certified welder, familiar with the welding requirements specified in the plans and specifications for the lift-slab operation, must perform all welding on temporary and permanent connections. Do not execute load transfer from jack/lifting units to building columns until the welds on the column shear plates cool to air temperature.
- f. Make sure jacks/lifting units are secured to building columns so they do not dislodge or dislocate. Design and install equipment so the lifting rods cannot slip out of position.

### 25.13 Masonry Construction

**25.13.1 Requirements.** Establish a limited access zone when erecting a masonry wall. The limited access zone must equal the height of the wall to be constructed, plus 4 feet, and must run the length of the wall. Establish the limited access zone before starting construction and locate it on the side of the wall that will not be scaffolded. Only employees directly involved in the construction of the wall may enter the limited access zone. The limited access zone must remain in place until the wall is adequately supported to prevent collapse. The supports must be able to withstand a load of at least 15 pounds per square inch. Walls over 8 feet high must have supports in place until permanent supporting elements of the structure are in place.

**25.13.2 Equipment.** Guard masonry saws with (a) a semicircular enclosure over-blade and (b) a slotted horizontal hinged bar mounted underneath the guard enclosure to retain fragments of shattered blades. Equip saws with dust-control systems or make provisions for wet sawing that control airborne dust concentrations.

**25.13.3 Scaffolding.** Design masonry scaffolding for a minimum loading of 50 pounds per square foot. In all other respects, design, install, inspect, and maintain masonry scaffolding in accordance with applicable provisions in the section, "Walking and Working Surfaces."